

Mountain Goats in Yellowstone: The Horns of a Dilemma?

In the 1940s and '50s, personnel from what was then the Montana Fish and Game Department introduced mountain goats (*Oreamnos americanus*) into several areas north of Yellowstone NP, primarily to increase recreational opportunities for hunters. Little did the Montana personnel of that day dream that their actions would result in a major dilemma for the National Park Service.

Mountain goats are part of the native fauna of several mountain ranges in Montana, Idaho, and Washington, but by all available information they did not occur historically in the Greater Yellowstone Ecosystem. Because of the transplants made by Montana personnel, there are now goats in the Yellowstone Ecosystem and descendents of these transplants now are on the verge of colonizing the park.

Goats moving into the park present a major conflict with NPS mandates that stipulate the preservation of native faunal and flora complexes. Introduction of "exotic" species into an area usually occurs at the expense of native species; consequently, exotic introductions are viewed as a threat. Because of this negative impact, NPS policy stipulates exotic species must not be allowed "to displace native species if this displacement can be prevented by management." (Anon. 1988).

So the decision would seem to be straightforward: Goats are exotics; as such, they should not be allowed to become established in the park. However, it turns out not to be as simple as it seems. Two factors complicate the issue. Goats ARE historically native to areas as little as 60 km to the west of the Yellowstone Ecosystem – areas ecologically similar to the Ecosystem. It remains a mystery why the relatively high mountain passes would have acted as a barrier to "natural" movement of goats to the east.

Regardless, mountain goats cannot be considered ecological exotics to the faunal and floral complexes found in the Yellowstone area. Animals and plant species similar to those found in the Ecosystem have evolved with goats in close proximity. One might argue that the specific animal and plant populations in the Yellowstone Ecosystem didn't evolve with goats and so may not have developed the defenses found in populations sympatric with goats.

However, this brings us to the second point of the dilemma. Goats may not be historic *natives* to Yellowstone, however, based on fossils from the Palisades, Idaho area, they were Pleistocene residents of the Greater Yellowstone Ecosystem approximately 30,000-70,000 years B.P. No more recent evidence of goats has been found in the area, but as little as 10,000 B.P., goats extended south to Mexico and east to central Wyoming (Mead 1983) with the proposed dispersal route being through the Yellowstone area (Mead 1983). The more southern prehistoric populations are designated as a separate species, *Oreamnos harringtoni*, Harrington's mountain goat. However, the specimens from central Wyoming are classified as the same species that is currently native to areas a few kilometers from the Greater Yellowstone Ecosystem.

All this clouds the issue of whether goats truly are native to the Yellowstone Ecosystem. However, the question still remains: what will be the impact of mountain goats on the current fauna and flora of Yellowstone

NP if and when goats become established, or re-established. To determine their impact, I perused existing data to use in developing an environmental assessment of goats of the Greater Yellowstone Ecosystem. There were two major emphases. First, I tried to determine the potential number of goats we can expect to inhabit the park. This is a critical point because it could determine the impact goats would have on park vegetation. Workers in Olympic NP found it wasn't so much that goats were selectively eating rare plants but that the sheer numbers of animals increased their impact



on *all* plants, including the rare and endemic ones. They also found the wallowing behavior of goats, exacerbated by their numbers, caused extensive plant destruction and soil erosion. All these impacts would have been less severe if goat numbers had not become so high – 14 goats/km² (Stevens 1983).

Goat densities vary from area to area. The lowest density of goats I found reported in the literature was 0.2/km² in British Columbia (Herbert and Turnbull 1977) and the highest was 15.4/km² in Glacier NP (Singer and Doherty 1985). Swenson (1985) found a density of approximately 0.4 goats per km² in the mountains just north of Yellowstone NP. This is near

the lowest estimate reported, so I used this density to estimate a low population level.

Based on the range of densities reported for areas similar to Yellowstone, I came up with a high estimate of 1.9/km². The next step was to determine, *a priori*, how much goat habitat might exist in the park. As an estimate, I used the amount of current bighorn sheep habitat, 250 km². Based on these figures, I estimated a low population of 95 and a high of 475 goats.

At the low density of goats, no major impact on park vegetation is expected. It is uncertain what impact the goats might have at the higher density. To determine the impact of higher densities of goats, I visited Glacier NP. In the area near Logan Pass, where goats are at a density of approximately 2.8 goats/km² (Chadwick 1974), no measurements were taken, but no obvious signs of overgrazing or erosion from wallowing were evident. So, at the projected high density of goats for Yellowstone, no major impact of goats on the vegetation is expected. This is in contrast to what has happened at Olympic NP. Perhaps the higher density of goats at Olympic, their greater wallowing because of the warmer climate, and the intensification of these factors by high amounts of rainfall, all contributed to the goats' negative impacts there.

The second emphasis of my work was to determine the potential impact of goats, regardless of their numbers, on their nearest ecological relative, bighorn sheep (*Ovis canadensis*). Bighorns traditionally have been considered the symbols of Yellowstone wilderness. Unlike other ungulates such as elk, deer, or bison, sheep live in the high elevations and rarely are seen by the casual visitor. To see a sheep means either that you had the fortitude to hike to their haunts or that you are extremely lucky. To lose this charismatic species would diminish the park's wilderness value.

To determine the potential impact of mountain goats on sheep, I estimated how much their food and habitat requirements overlapped by using existing data to calculate resource overlap indices (Lawlor 1970). Based on data from unrelated studies for general food categories (grass, forbs, and shrubs), goats and sheep diets would seem to overlap extensively (Fig. 1a). Even separation of diets into more specific categories would lead to the same conclusion (Fig. 1a).

However, comparison of diets from independent

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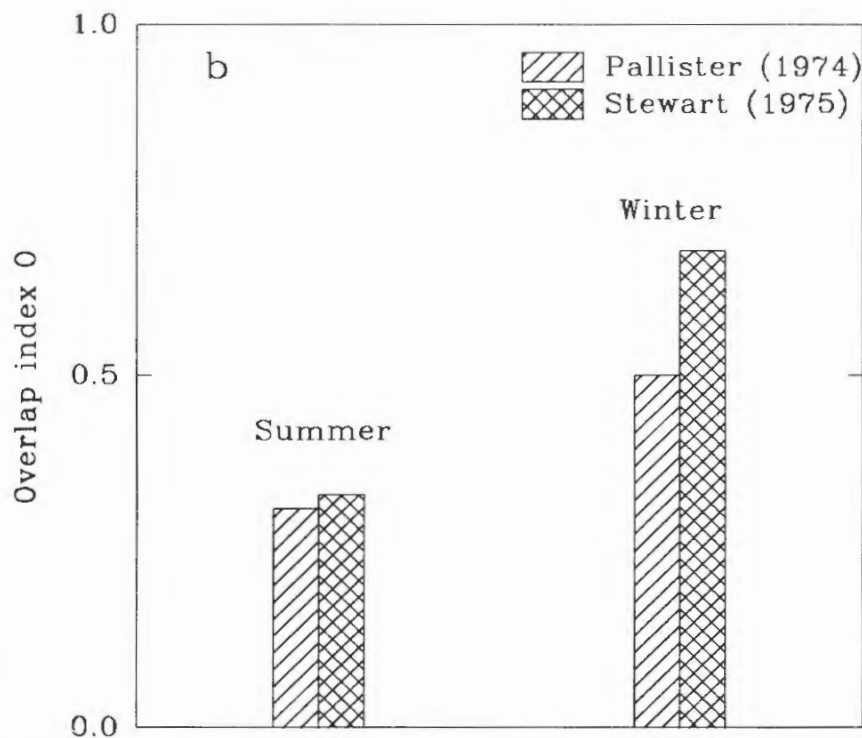
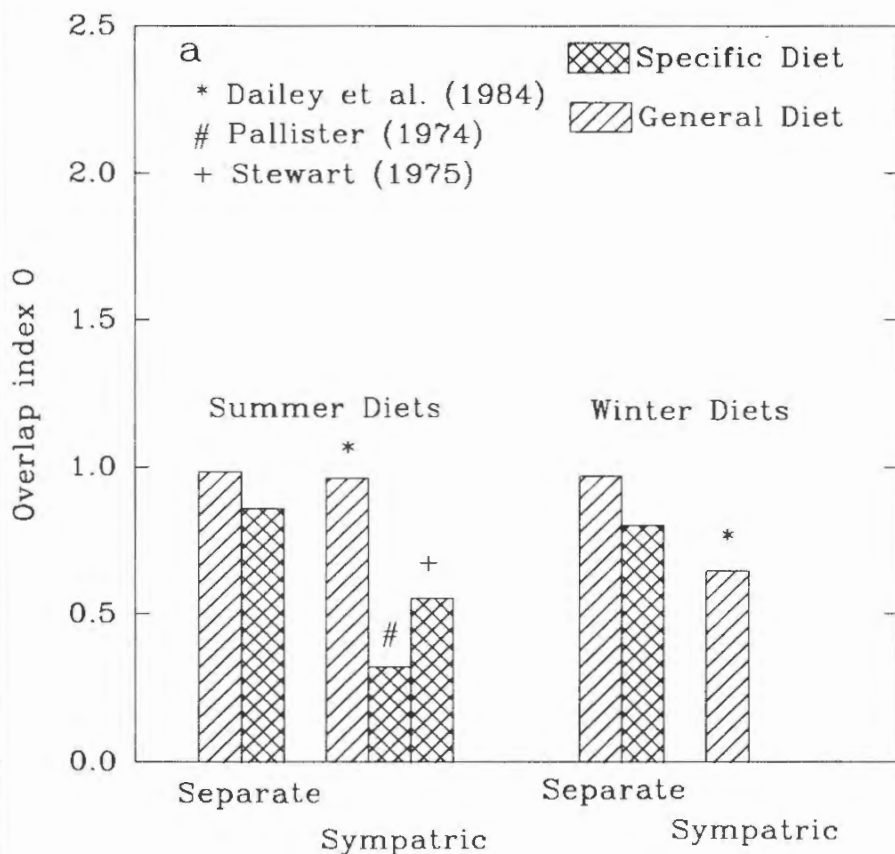


Figure 1. Niche overlap indices for food habits (a) and selection (b). Overlap indices for food are for pooled data from separate studies and data from comparative studies and are based on either general (grass, forbs, shrubs) or specific (to genera) food classifications. Indices for habitat selection are all from two comparative studies of sympatric sheep and goat populations.

studies present problems relative to food availability and presence or absence of competitors. The best way to determine the amount of actual overlap between goats and sheep is to compare diets of sympatric populations. Three investigators have done this. Dailey et al. (1984) compared general diets (grass, forbs, and shrubs) of sympatric goats and sheep in Colorado. Based on their data, the resource overlap index for summer diets was similar to unrelated studies (Fig. 1a). However, during the winter, resource overlap reduced substantially (Fig. 1a). Pallister (1974) and Stewart (1975) compared specific plant species used by goats and sheep in the Beartooth mountains just north of Yellowstone. Based on their data, the resource overlap indices were only half of what separate unrelated studies indicated (Fig. 1a).

Relative to habitat requirements, the only reliable comparisons that can be made are from studies of sympatric populations. Again, data from Pallister (1974) and Stewart (1975) indicated substantial habitat separation (Fig. 1b). It is important to note that the studies by Dailey et al. (1984), Pallister (1974), and Stewart (1975), were of "exotic" goats that had been transplanted into native sheep range. Thus goats and sheep are seemingly able to coexist, even when goats are "non-native" introductions, and goats will likely not exclude sheep from Yellowstone NP. Whether goats will significantly reduce sheep numbers is unknown at this time and will depend on which population level scenario proves accurate.

So, in conclusion, whether goats are to be considered exotics or prehistoric natives is a decision to be made by NPS personnel, luckily! If left uncontrolled, goats will continue to colonize Yellowstone NP and will reach a population of between 100 and 500 animals. The potential impact of mountain goats on Yellowstone flora is estimated to be not as severe as it was in Olympic NP. The presence of goats in the park also is not expected to affect adversely the continued survival of bighorn sheep. Some changes, however, likely will occur as Yellowstone adjusts to the return of one of its prehistoric residents.

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